ODONATA IN RELATION TO THE HYDROPHYTIC ENVIRONMENT.

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All species of dragonflies are aquatic in the larval stage, and therefore, the Odonata as a group belongs to the fauna of the hydrophytic area.

The eggs are deposited in the water, either by the process of "dipping," by which the eggs are washed from the tip of the abdomen of the female, or, in some cases, the female rests with the tip of the abdomen beneath the surface of the water while the eggs are being laid. In the latter case, the eggs are usually deposited singly in incisions made in the stems of aquatic plants by means of the genital valves. In other cases the eggs fall to the bottom singly, as a rule, though the species of *Tetragoneuria* and *Epitheca* deposit an egg-mass in the form of a gelatinous string. A few of the tropical species lay eggs in water caught in the cups formed by the leaves of Bromeliads. The time required for hatching varies from a few days to several weeks, depending upon the temperature of the water, and the young larvæ emerge to begin their aquatic life. They are predaceous, feeding upon various kinds of aquatic animals, chiefly other insects which they capture by means of the peculiar extensile labium. The larger larvæ often devour young fishes, tadpoles and even smaller individuals of their own species.

Two distinct types of respiration are represented among the dragonfly larvæ. In the small species known as demoiselles (suborder Zygoptera) there are thin, flattened, leaf-like, terminal appendages of the abdomen which are adapted to the absorption of oxygen from the water. In the larger, more robust forms, dragonflies (suborder Anisoptera), a unique method of respiration has been evolved. The rectum is greatly expanded, the walls convoluted to form a system of gills in which there are thousands of tracheal endings. By rhythmic pulsations the water is alternately drawn in and expelled from the rectum, and the rectal gills serve to extract the oxygen from the water. This same apparatus also serves as a locomotor organ in swimming by the members of this same group. Forcible expulsion

of the water serves to drive the larva forward in the water, a method of swimming found otherwise in jellyfishes, cephalopods and salps. The larvæ of the demoiselles swim by an undulatory movement of the body.

The habits of the larvæ vary considerably. Those of the demoiselles and certain of the larger forms, especially of the Æshninæ, climb about among water plants, and such forms are usually green-colored as a protective adaptation. The larvæ of the Gomphinæ and Libellulinæ wander over the bottom, or partially or entirely bury themselves in the mud and muck. These are brownish or gray, neutral-colored forms and are usually covered more or less by particles of the debris among which they live. Many species are widely distributed and are found in almost all sorts of localities, appearing to have no special choice as to whether they inhabit streams or ponds. Other species, again, are limited to particular habitats, such as spring-fed brooks, rapid creeks or stagnant ponds and marshes. Some of the species mature in a year, others, it is said, spend as long as three years in the larval condition.

Numerous species are known to breed in brackish water, and, as the writer has shown (American Naturalist, Vol. XL, June, 1906, pp. 395–9), they are capable of withstanding a salinity equal to about half that of pure sea-water. Schwarz ("Preliminary Remarks on the Insect Fauna of the Great Salt Lake, Utah," Canadian Entomologist, Vol. XXIII) has also recorded certain species as inhabiting salt and sulphurous ponds in Utah, and the writer has observed others in slightly alkaline ponds in North Dakota. These same species breed also in pure fresh water and some of them are distributed from coast to coast. Two species, *Erythrodiplax berenice* and *Ischnura ramburii,* are restricted to a coastwise distribution along the Atlantic and Gulf of Mexico. The exact reasons why these forms that may breed in brackish water are unable to breed in water having a higher salinity, such as pure sea-water, has not been determined.

Before the time of transformation the larvæ often crawl out of the water for brief periods, breathing by means of the spiracles, and when the time has arrived for shedding the larval skin the insect crawls out upon the bank or upon a stick or waterplant projecting above the surface, splits down the back of the thorax and emerges in the winged condition. The adults of the larger species are, as a rule, strong

fliers and often range very widely from their breeding places. Especially is this true of the females, which may often be found far away coursing through the woods, along the roads, or over fields in search of food. The male will often patrol a selected reach of stream or area of a pond, viciously attacking any other male of his own or another species which happens to wander into his chosen territory.

Libellula pulchella and *Plathemys trimaculata* are much given to perching on sticks, cat-tails and in other exposed situations in the bright sunlight. Gomphines are most frequently seen when at rest, perched upon stones or upon the dry banks of streams or ponds. Some strong flying species, such as *Anax junius* and the Æshnas are seldom seen at rest in the daytime, and often continue their search for prey during the twilight hour, though a crepuscular habit is not common to the group.

Boyeria vinosa is usually found in shaded situations along streams, and the *Somatochloras* frequently wander far into the forests. The small Libellulines, *Perithemis domitia* and *Nannothemis bella* seldom are found very far from the lily-pads and the open water at the edge of pools and lakes. On the other hand the species of *Sympetrum*, a related genus, range far afield.

The small, thin-bodied demoiselles usually do not wander far and generally fly low among the grasses and weeds, or hover close over or rest upon the lily-pads and floating vegetation of the marshes. The species of *Agrion* (*Calopteryx*) are fond of shady places along the creeks and springs.

Notes on the habits and occurrence of our local species are given by Mr. Wm. T. Davis in the paper which follows this.

DRAGONFLIES OF THE VICINITY OF NEW YORK CITY WITH A DESCRIPTION OF A NEW SPECIES.

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In this Journal for March, 1895, Dr. Philip P. Calvert published a list of "The Odonata of New York State," and in the June, 1897, number, appeared his "Additions to the Odonata of New York State."